March 31, 2021

EX PARTE NOTICE

Marlene H. Dortch, Secretary
Federal Communications Commission
45 L Street NE
Washington, DC 20554

Re: Ex Parte Presentation in Facilitating Shared Use in the 3100-3550 MHz Band, WT Docket No. 19-348

Dear Ms. Dortch:

DISH Network Corporation ("DISH") respectfully submits this *ex parte* to provide additional technical input on its recent ask for a new Public Notice to seek comment on raising maximum authorized power levels in the in Citizens Broadband Radio Service ("CBRS") band.[1] DISH discussed the attached presentation (Attachment 1) during a telephone call on March 29, 2021 with staff in the Wireless Telecommunications Bureau ("WTB") and Office of Engineering and Technology ("OET").[2]

With the recent launch of Auction 110 for the 3.45-3.55 GHz band ("3.45 GHz Band"), the Commission should think holistically about mid-band spectrum to maximize the efficient use of these valuable airwaves. The current CBRS rules limit the band's use for macro-cell 5G deployments, due to Priority Access License ("PAL") holders having to protect incumbent users and operate at lower transmit power, among other reasons. Unless CBRS power levels are aligned with neighboring bands, PAL holders face a competitive disadvantage. Maintaining the status quo would leave the CBRS band sandwiched between the 3.45 GHz Band and the 3.7 GHz Band, both of which would have services rules optimized for large-scale, wide-channel 5G service offerings.

As DISH explains in this new technical analysis:

- Allowing higher power in the CBRS band (new Category C CBSDs allowed up to 62 dBm/10 MHz and new Category D CBSDs allowed up to 72 dBm /10 MHz) will not harm fair and dynamic usage of the spectrum.
- GAA, Incumbents and Category A/B CBSDs will not be harmed.

[1] *See* Letter from Jeffrey H. Blum, DISH, to Marlene H. Dortch, FCC, WT Docket No. 19-348, Mar. 5, 2021 ("DISH Proposal").

[2] The following FCC personnel participated in the call: Matt Pearl (WTB); Kamran Etemad (WTB); Paul Powell (WTB); Jessica Quinley (WTB); Ira Keltz (OET); and Tom Struble (OET). Present on behalf of DISH were: Stephen Bye, Executive Vice President; Jeff Blum, Executive Vice President; Sourabh Gupta, Director of Network Planning; William Beckwith, Director of Wireless Regulatory Affairs; Hadass Kogan, Director of Regulatory Affairs; and Alison Minea, Director of Regulatory Affairs.

- DISH found minimal impact on SAS and protection of environmental sensing capability ("ESC") users via simple coordination facilitated by the SAS.
- Higher power CBRS will result in increased end user 5G data rates, providing equitable benefits to the many CBRS auction winners and GAA users.
- DISH also noted potential impacts to carrier aggregation due to current CBSD power limitations.

Please contact me with any questions regarding this submission.

Sincerely,

/s/

Jeffrey H. Blum
DISH Network Corporation

cc: Kamran Etemad
Ira Keltz
Matt Pearl
Paul Powell
Jessica Quinley
Tom Struble

Attachment 1: DISH Wireless, *Higher Power CBSD (PAL and GAA) Discussion*, March 29, 2021

dish wireless

Higher Power CBSD (PAL and GAA) Discussion

March 29, 2021

Overview

This analysis supplements DISH Network Corporation's filing (Mar. 5, 2021, WT Docket No. 19-348) proposing a new Public Notice to align CBRS power levels with the surrounding 3 GHz services (3.45-3.55 GHz and the 3.7 GHz C-band). We show that allowing higher power in the CBRS band (new Category C CBSDs allowed up to 62 dBm/10 MHz and new Category D CBSDs allowed up to 72 dBm /10 MHz) will not harm fair and dynamic usage of the spectrum as envisioned by the Commission:

- GAA, Incumbents and CAT A/B CBSDs will not be harmed
- Minimal impact on SAS and protection of ESCs (DPAs) via simple coordination facilitated by the SAS
- Higher power CBRS will result in increased end user 5G data rates, providing equitable benefits to the many CBRS auction winners and GAA users
- Using sample network designs with higher power CBSDs deployed, we demonstrate more efficient use of CBRS spectrum while continuing to comply with current technical rules
- Highlight secondary impact on Carrier Aggregation due to current CBSD power limitations

In summary, we see that higher power in the CBRS band will result in increased and efficient utilization and consumer benefits, but also acknowledge that additional work needs to be done.

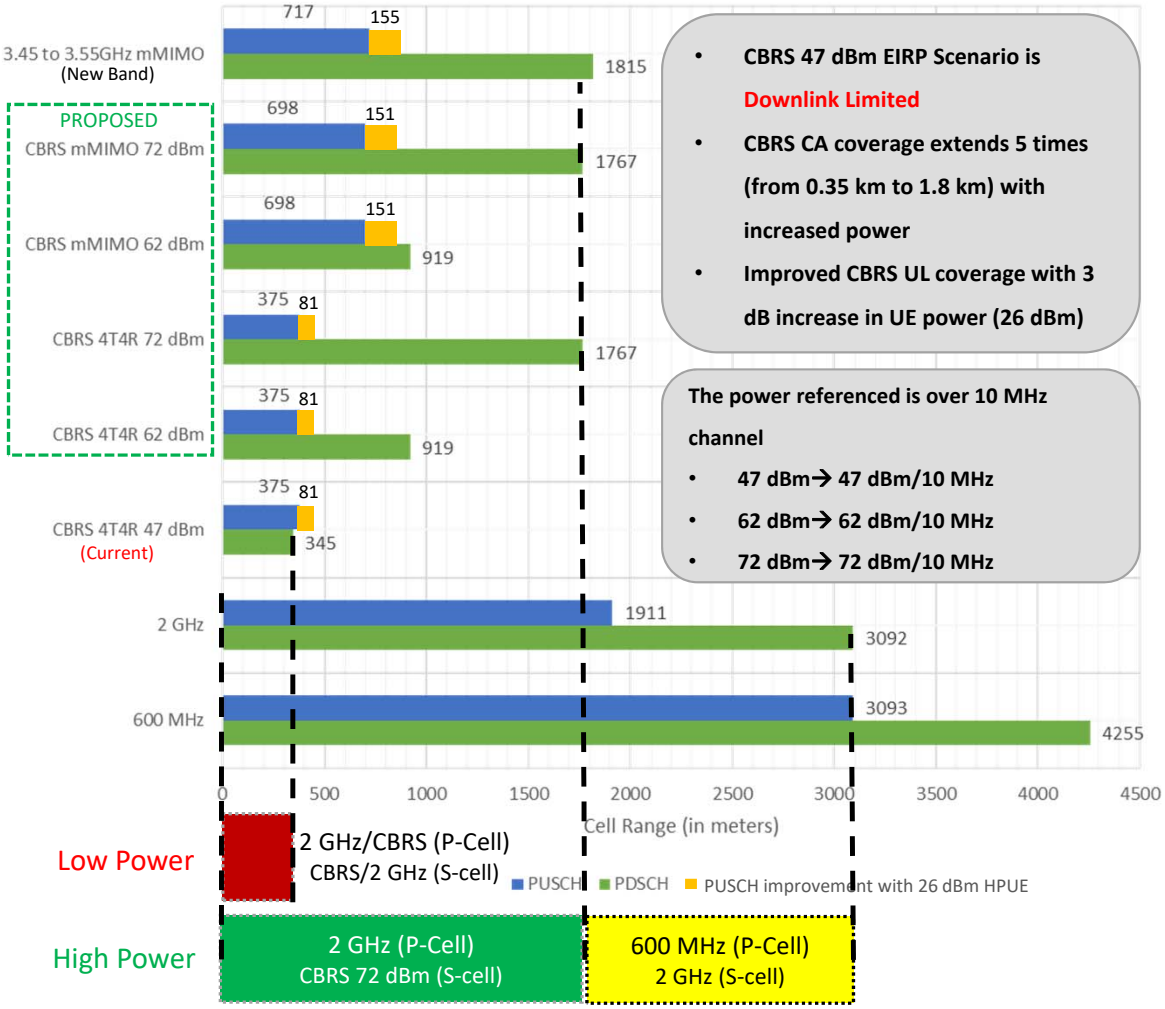
Higher Power Impact on Capacity

Assumptions

- **FDD Bands and Bandwidth (Exemplary):** 600 MHz – 10 MHz (15 kHz SCS); 2 GHz band – 10 MHz (15 kHz SCS)
- **TDD Band and Bandwidth:** CBRS, 3.45-3.55 GHz – 10 MHz (30 kHz SCS) DL:UL Split Ratio (%) – 80:20
- **DL Transmit Power, MIMO Configuration, Antenna Gain**

Frequency Band	MIMO Configuration	TX Power (Watts)	BS Antenna Gain (dBi)	UE Antenna Gain (dBi)	BS EIRP (dBm)	UE EIRP (dBm)
600 MHz	4T4R	4x 30W	14.2	-6	64.5	17
2 GHz	4T4R	4x 40W	18	-3	69.5	20
CBRS	4T4R	4x 0.25W; 4x 8W; 4x 79W	17.5	-2	47, 62, 72	21/24
	64T64R	6W; 56W	24.5 (including BF Gain)	-2	62, 72	21/24
3.45-3.55 GHz	64T64R	56W	24.5 (including BF Gain)	-2	72	21/24

- **BS Noise Figure:** 2.5 dB (FDD); 3 dB (TDD)
- **UE Noise Figure:** 9 dB (600 MHz); 7 dB (2 GHz, CBRS, 3.45-3.55 GHz)
- **Cell Edge Assumptions***
  - 600 MHz: DL -> 2 Mbps, UL -> 256 Kbps
  - 2 GHz: DL -> 2 Mbps, UL -> 256 Kbps
  - CBRS, 3.45-3.55 GHz: DL -> 2 Mbps, UL -> 256 Kbps
- **Channel Model**: Tapped Delay Line Model B (43ns Delay Spread), 3km/hr
- **Propagation Model:** Cost-231 ; BS height = 30m; and UE height = 1.5m



- **CBRS 47 dBm EIRP Scenario is Downlink Limited**
- **CBRS CA coverage extends 5 times (from 0.35 km to 1.8 km) with increased power**
- **Improved CBRS UL coverage with 3 dB increase in UE power (26 dBm)**

The power referenced is over 10 MHz channel

- **47 dBm→ 47 dBm/10 MHz**
- **62 dBm→ 62 dBm/10 MHz**
- **72 dBm→ 72 dBm/10 MHz**

	600 MHz	2 GHz	CBRS 4T4R 47 dBm	CBRS 4T4R 62 dBm	CBRS 4T4R 72 dBm	CBRS mMIMO 62 dBm	CBRS mMIMO 72 dBm	3.45-3.55 GHz mMIMO
PDSCH	4255	3092	345	919	1767	919	1767	1815
PUSCH (23 dBm)	3093	1911	375	375	375	698	698	717

*Average Global DL/UL Asymmetry is 10:1 but in USA, the number is ~ 8:1

RF Analysis – El Paso County, CO

County	Area (Sq.Km)	Pops
El Paso	5,512	622,268

- **Case 1:** Sample RF Design for 2 GHz band on macro sites, the green area is the Service Area
- **Case 2:** Overlay the macro sites in Case 1 with CBRS 4T4R (current 47 dBm max EIRP), evaluate coverage
- **Case 3:** Densify Case 2 with new small cells at 10m height (47 dBm max EIRP) to fill in coverage gaps
- **Case 4 (Proposed High Power):** Overlay the macro sites in Case 1 with mMIMO sites and densify with new small cells (4T4R) at 10m height (47/62 dBm max EIRP)

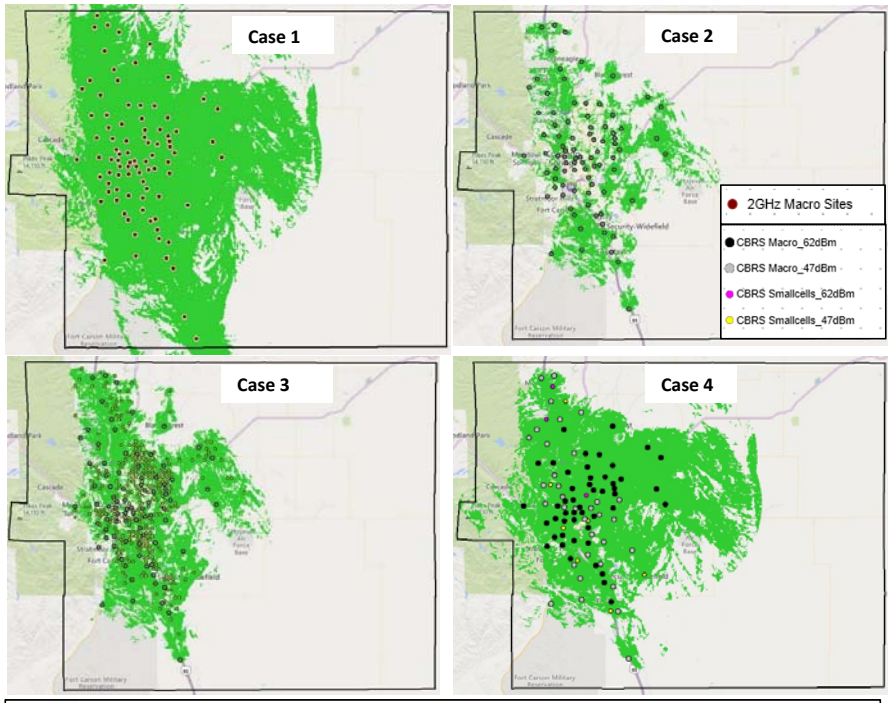
** Design based on link parameters shown in previous slide**

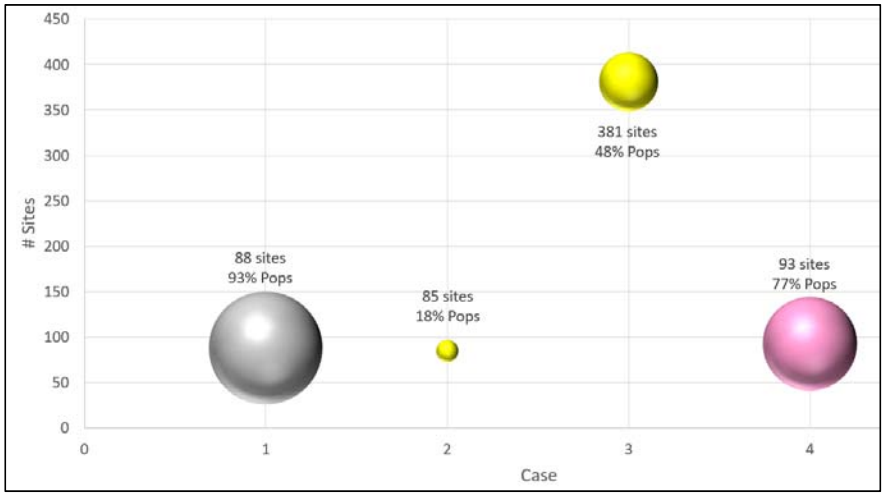
Case	# Sites					% Area Covered	% Pops Covered	% DL CoMP (Pops)	% Pops with DL Throughput*		
	Total	Macro		Small Cells					> 50Mbps	> 20Mbps	> 10Mbps
		47 dBm	62 dBm	47 dBm	62 dBm						
Case 1	88	-	-	-	-	35.7	92.8	84.0	12.6	63.2	91.1
Case 2	85	85	-	-	-	8.2	17.6	5.3	1.4	14.6	17.6
Case 3	381	85	-	296	-	14.3	47.8	22.7	2.1	30.6	47.0
Case 4	93	34	49	7	3	26.2	76.9	54.4	3.8	42.3	73.9

*10MHz Bandwidth assumed in all Cases, throughput is per Band

PPA Interference Analysis (-96 dBm/10MHz) performed for Case 2, 3 and 4 sites to ensure compliance with the thresholds.

- **Low Power CBRS when overlaid over Macro sites provides only ~ 20% coverage**
- **Significant number of Low Power CBRS sites are required to provide coverage similar to 2 GHz Service Area**
- **High Power CBRS radio provides significantly better coverage within Service Area**





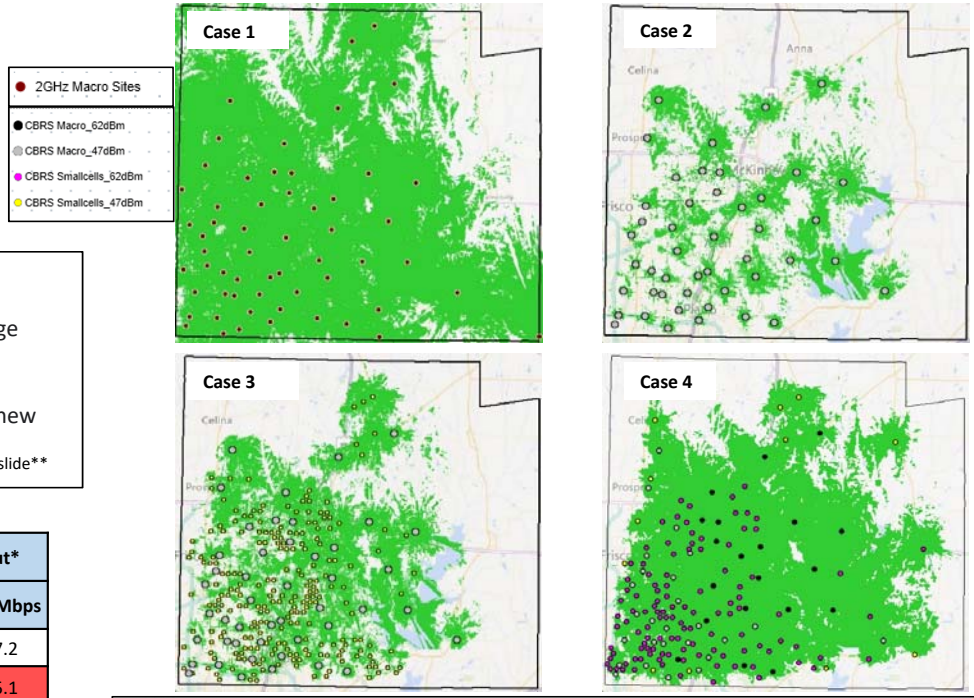
47 dBm Scenario
62 dBm Scenario
2 GHz Scenario (Baseline)

RF Analysis – Collin County, TX

County	Area (Sq.Km)	Pops
Collin	2,296	780,993

- **Case 1:** Sample RF Design for 2 GHz band on macro sites, the green area is the Service Area
- **Case 2:** Overlay the macro sites in Case 1 with CBRS 4T4R (current 47 dBm max EIRP), evaluate coverage
- **Case 3:** Densify Case 2 with new small cells at 10m height (47 dBm max EIRP) to fill in coverage gaps
- **Case 4 (Proposed High Power):** Overlay the macro sites in Case 1 with mMIMO sites and densify with new small cells (4T4R) at 10m height (47/62 dBm max EIRP)

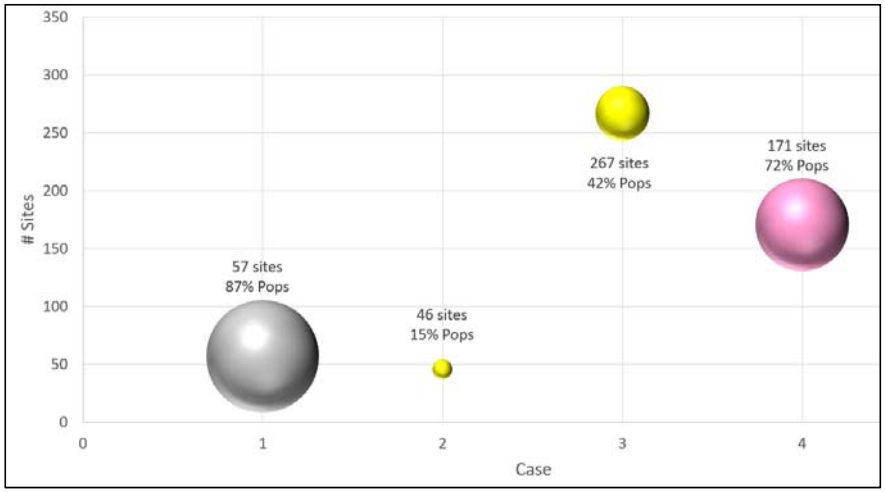
** Design based on link parameters shown in previous slide**



Case	# Sites					% Area Covered	% Pops Covered	% DL CoMP (Pops)	% Pops with DL Throughput*		
	Total	Macro		Small Cells							
		47 dBm	62 dBm	47 dBm	62 dBm				> 50Mbps	> 20Mbps	> 10Mbps
Case 1	57	-	-	-	-	72.8	87.2	57.6	19.3	73.8	87.2
Case 2	46	46	-	-	-	19.0	15.2	4.5	1.3	12.9	15.1
Case 3	267	46	-	221	-	32.4	42.0	20.3	2.3	28.9	41.7
Case 4	171	26	20	12	113	53.3	71.6	47.9	4.1	39.5	69.2

*10MHz Bandwidth assumed in all Cases, throughput is per Band

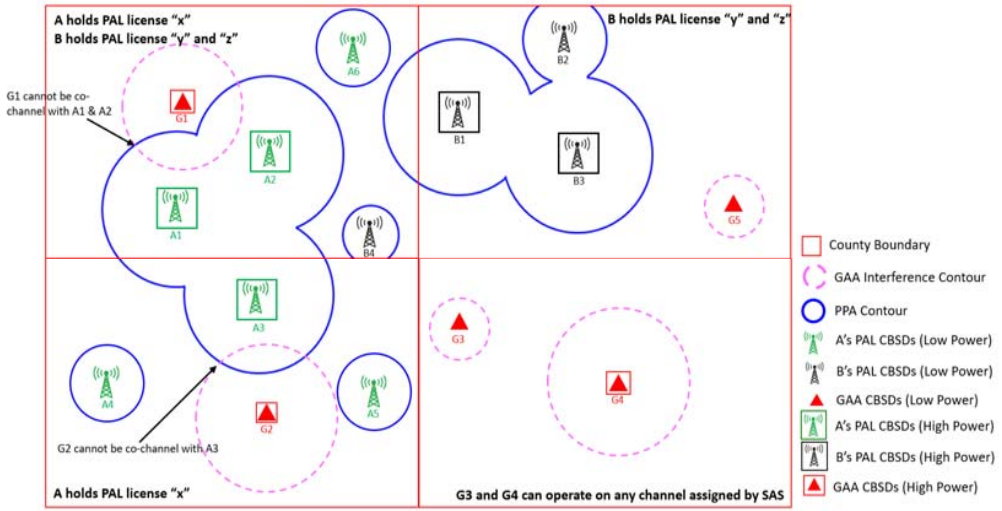
PPA Interference Analysis (-96 dBm/10MHz) performed for Case 2, 3 and 4 sites to ensure compliance with the thresholds. High population density close to county boundary requires small cell deployment to comply with license thresholds.



- **Low Power CBRS when overlaid over Macro sites provides only ~ 18% coverage**
- **Significant number of Low Power CBRS sites are required to provide coverage similar to 2 GHz Service Area**
- **High Power CBRS radio provides significantly better coverage within Service Area**

47 dBm Scenario
62 dBm Scenario
2 GHz Scenario (Baseline)

Low Power GAA & PAL will be protected from CBRS High Power



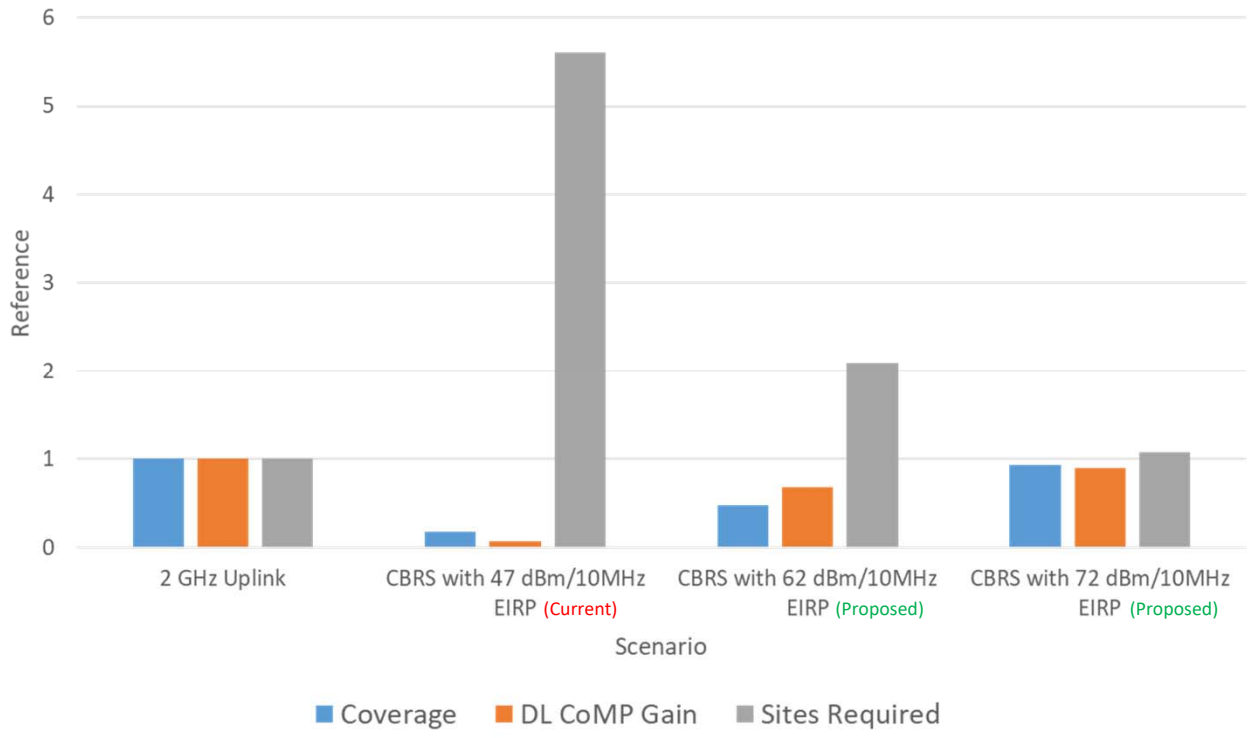
GAA

- As shown on the left, and also in the sample market designs, there will be a deployment combination of Low Power and High Power CBSDs within the license area to comply with licensee thresholds within the **Service Area**.
- GAA users operating within the PPA contours can continue to operate at both proposed High and current Low powers on adjacent channels.
- Irrespective of the power levels, the CBSDs (via SAS) will have to coordinate including TDD synchronization else it will result in large exclusion areas.
- For adjacent channels, CBRS radios (any Category) need to support In-Band Emission mask of -13dBm/MHz. The same requirement is applicable to other adjacent bands such as C-band and 3450-3550 MHz band. There is no impact on lower power GAAs.
- All CBRS radios (any Category) require compliance with Out-of-band emission masks i.e. -13 dBm/MHz, -25 dBm/MHz and -40dBm/MHz thresholds to avoid interference to the adjacent bands.

ESC (DPAs) and SAS

- The ESCs will be protected from any harmful interference (<-144dBm/10 MHz). Similar to the construct shown above, the CBSDs within the DPA neighborhoods can operate at different power levels and coordinate with ESC operators. As currently proposed, during radar activity, CBSDs with highest interference contribution to a DPA will continue to have their spectrum grant suspended or terminated on the frequency range than DPA requires protection until the aggregate interference from remaining CBSDs is below the protection threshold.
- Within DPA, whether a given CBSD is impacted or not depends on its frequency of operation and its predicted contribution to the interference estimated by the SAS. This operation and procedure does not change with the proposed higher power Category CBSDs.
- Only minor changes are required within SAS to calculate the service contour and define neighborhood limits of Cat C and D CBSDs.
- Overall, as done today, it will be the responsibility of SAS to perform channel assignments and authorize the use of actual power level for each CBSD.

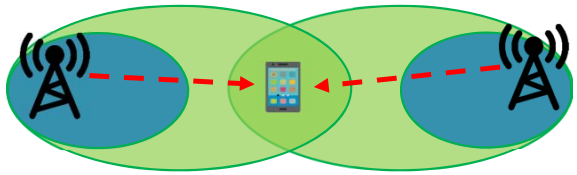
Cluster Analysis Summary



ASSUMPTIONS

- 2 GHz Link Budget (256 Kbps UL Throughput) as Baseline
- CBRS Link Budget (2 Mbps DL Throughput)
  - 47 dBm EIRP
  - 62 dBm EIRP
  - 72 dBm EIRP
- The bar graphs on left show averaged numbers based on RF Analysis performed on the two previous counties
- 47 dBm scenario includes a mixture of Macro Sites and Small Cell sites (10m height)

Downlink Coordinated Multipoint



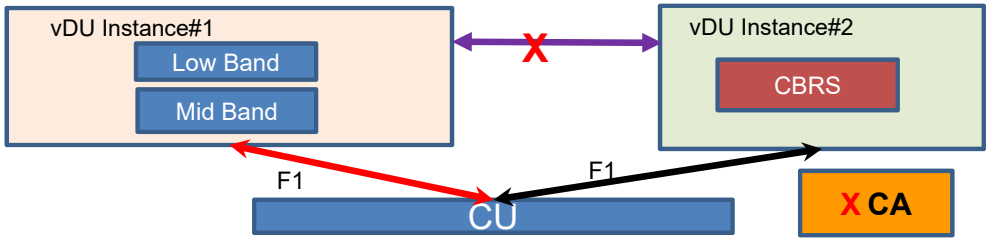
2 GHz UL and CBRS (72 dBm/10MHz EIRP) coverage

CBRS (47 dBm/10MHz EIRP) coverage

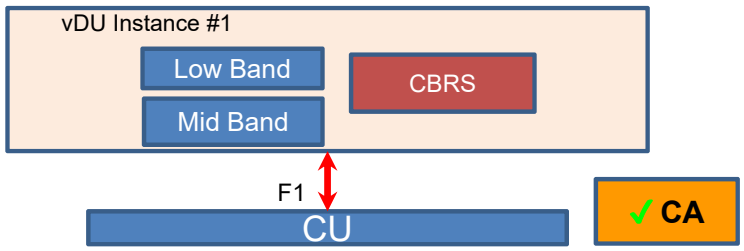
- CBRS Downlink coverage with EIRP of 72 dBm is comparable to 2 GHz Uplink coverage
- More than 6x sites are required to provide contiguous coverage on CBRS with 47 dBm EIRP to match 2 GHz grid
- CoMP gain advantage with higher power CBSDs

High Power facilitates CA in ORAN based Deployed Network

CBRS Low Power (Small Cell) Deployment
FDD & CBRS DUs Non-Colocated

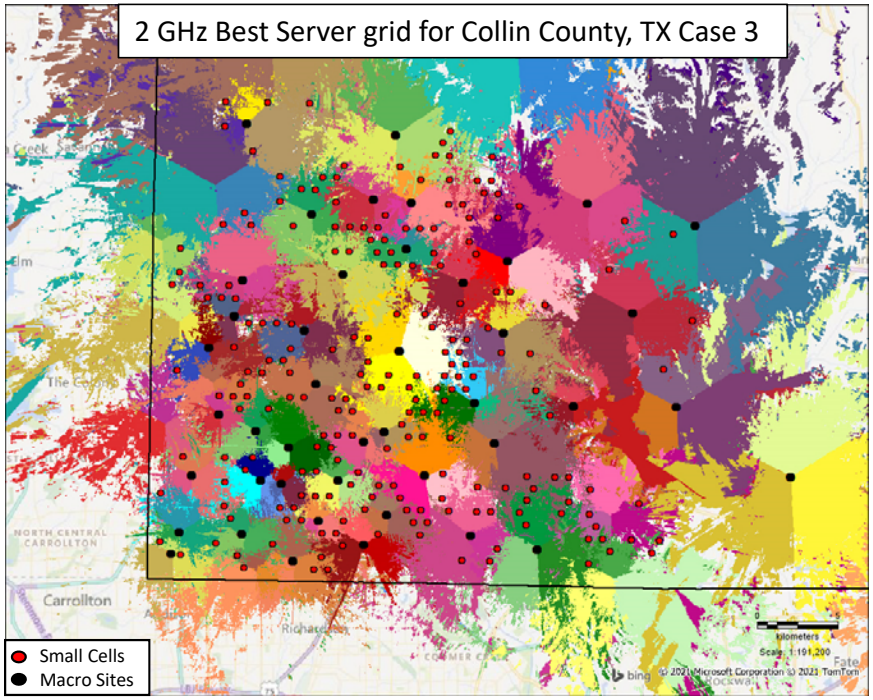


CBRS High Power (Macro Cell) Deployment
FDD & CBRS DUs Co-located



- Carrier Aggregation requires tight communication between RLC and MAC layers of the aggregated cells.
- With ORAN 7.2x split, RLC and MAC layers are managed by the DU. For carrier aggregation operation, there are two scenarios:
  - **Scenario 1**: Aggregated cells are managed by non-colocated DUs. Currently 3GPP and ORAN standard do not support the interface between different DUs. In addition, there is a very strict Inter-DU latency requirement (<200usec) for Carrier Aggregation to work, requiring dark fiber links to each small cell which places further deployment restrictions. These two limitations create a challenge for operator to provide benefit of CA.
  - **Scenario 2**: All cells managed by co-located DUs. Carriers can be aggregated without any proprietary or standardized interface between the aggregated carriers. As shown in the earlier analysis, this deployment is more efficient with higher power support in CBRS.
- To clarify, this problem is not specific to CBRS, but the low power only deployment makes it harder.
- Alternatively, Dual Connectivity can be used theoretically but there is no UE ecosystem to support this for NR <6GHz. Further, NR-DC requires the two uplinks to be active at all times which reduces power per band.

Carrier Aggregation Impact



Macro Site	# Cat B CBRS Small cells required to supplement coverage
Macro Site1	12
Macro Site2	10
Macro Site3	10
Macro Site4	9
Macro Site5	8
Macro Site6	7
Macro Site7	7
Macro Site8	6
Macro Site9	6
Macro Site10	6
Macro Site11	6
Macro Site12	5
Macro Site13	5
Macro Site14	5
Macro Site15	5

- Up to 12 low power small cells are required to supplement coverage of a single Macro site.
- For Carrier Aggregation operation with other FDD bands, Small Cells need to connect to a macro site where DU is located over Dark Fiber links.
- Dedicated Dark Fiber is not available to each of the small cell locations.
- This adds extra costs and complexity in the transport design and additional consideration for networking gear (e.g. Cell Site Router ports and throughput)

